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Scalar implicatures vs. Presuppositions: the view from Broca’s aphasia*

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1. Introduction

We report on an experimental investigation of Scalar Implicatures (SIs) and Presuppositions (Ps) in individuals with Broca’s Aphasia (BAs) as compared to typical adults (TAs) and children. The (b)-inferences for the (a)-sentences below illustrate SIs and Ps respectively:

- (1) a. Not all of the giraffes have scarves.
b. \hookrightarrow *Some of the giraffes have scarves*
- (2) a. The Bear didn’t win the race.
b. \hookrightarrow *The Bear participated in the race*

The study contributes both a novel perspective on the comprehension abilities of BAs and new experimental data bearing on the theoretical analysis of SIs and Ps. BAs typically display impairments in interpreting syntactically ‘complex’ sentences (e.g. Grodzinsky 2000, Grillo 2005). This is commonly attributed to a processing deficit, which is posited to either affect syntax specifically (e.g. Burkhardt et al. 2008, Santi & Grodzinsky 2012), or processing resources more generally (e.g. Caplan et al. 2007, Avrutin & Baauw 2013). To date, little is known about whether pragmatic inferences such as SIs and Ps pose any difficulties for these individuals. This could plausibly be the case if (at least some of) these inferences are associated with a processing cost for typical adults, as has been argued in much recent literature (e.g. Bott & Noveck 2004, Huang & Snedeker 2009, Chemla & Bott 2014, Romoli & Schwarz 2014).

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In relation to the theoretical treatment of SIs and Ps, recent work in semantics and pragmatics has reconsidered the traditional distinction between these inferences (at least for certain P-triggers), with some authors arguing for a unified analysis (Chemla 2009a, Romoli 2013, 2014). While the relevant theories are not necessarily committed to specific accounts of these inferences in processing and acquisition, experimental work across populations nonetheless can inform the theoretical debate in crucial ways, as differences between them in processing and acquisition pose a challenge for unified accounts (see Chemla & Bott 2014 and Tieu et al. 2015 for discussion). Indeed, some recent work on language acquisition (Bill, Romoli, Schwarz, & Crain 2015) and typical adult sentence processing (Chemla & Bott 2014) reveal apparent differences between SIs and Ps, thereby posing at least *prima facie* challenges to a unified approach.

In this paper we show that the comparison of BA's performance on SIs and Ps to that of typical adults and children can provide a multidimensional perspective, with the potential for richer sets of conclusions in each of the two areas. In particular, BAs have commonly been found to struggle precisely with those complex constructions that emerge late in language acquisition (e.g. Jakobson 1971, Avrutin 2000). Moreover, existing experimental work has shown that children's behavioral responses to both types of inferences differs from those of adults (Noveck 2001, Bill et al. 2015), and also points to corresponding complexities in processing by typical adults (Bott & Noveck 2004, Huang & Snedeker 2009). In light of these findings, the present study was designed to directly assess the relation between the apparent processing limitations in BA and these previous findings. The main result is that BAs perform on par with adults on SIs, but display a response pattern to Ps that is more similar to that of children. We discuss implications for both our understanding of the comprehension impairment in BA and for theoretical accounts of the two inferences in question.

2. Background

2.1 Theoretical Background

2.1.1 Optionality: Readings with and without the inferences

As illustrated above, SIs and Ps are inferences that systematically arise for certain sentences. However, one of the important characteristics shared by both of these inferences is that, in certain contexts, they can be rescinded. This is illustrated in (3-a) and (4-a), where the continuation makes clear that the inference is not warranted. Also note the contrast with simple entailments in (3-b) and (4-b), which - of course - cannot be cancelled.

- (3) a. Some of the giraffes have scarves, in fact, all of them do!
b. Some of the giraffes have scarves #in fact, none of them do!
- (4) a. The Bear didn't win the race, in fact, he didn't even participate!
b. The Bear and the pig didn't come to the race, #in fact, the Bear came!

Theoretical accounts thus face the challenge of explaining both how the relevant inferences arise when they are present, as well as accounting for their absence in other cases.

2.1.2 Traditional Theoretical Approaches

Scalar Implicatures Under traditional approaches, following Grice (1975) and Horn (1972), SIs are derived from reasoning about speaker intentions in light of basic assumptions about co-operative communication: co-operative speakers generally aim to make maximally informative, relevant, and true statements. Roughly speaking, a speaker uttering a sentence with the weak scalar term *some*, as in (5-a), invites the hearer to infer that the speaker could not truthfully utter the more informative (5-b) with the *strong* scalar alternative *all*. This, in turn, leads to an interpretation of (5-a) as (5-c).

- (5) a. Some of the giraffes have scarves.
- b. All of the giraffes have scarves.
- c. \hookrightarrow *Some but not all of the giraffes have scarves*

The same account applies to strong scalar items under negation: a speaker uttering (6-a) instead of the relevant and more informative (6-b) leads the hearer to infer that (6-b) is false, resulting in the interpretation in (6-c).

- (6) a. Not all of the giraffes have scarves.
- b. It is not the case that some of the giraffes have scarves.
 (\approx none of the giraffes have scarves)
- c. \hookrightarrow *Not all of the giraffes have scarves, but some of them do*

Just as in the case of *some*, the inference in (6-b) is not necessarily present, e.g., when continuing (6-a) with *... in fact, none of them did*. While treated uniformly, the cases of (5-b) and (6-b) are sometimes referred to as a Direct Scalar Implicature (DSI) and Indirect Scalar Implicature (ISI) respectively. We will adopt this terminology here.

Presuppositions Ps are traditionally seen as appropriateness conditions on the conversational context, whereby a sentence such as (7-a) is assumed to be felicitous only if (7-b) is already established in the *common ground* (Stalnaker 1973). Unlike SIs, Ps are commonly assumed to be conventionally encoded in the lexical entry of presupposition triggers, such as the verb *win*.

- (7) a. The Bear won the race
- b. \hookrightarrow *The Bear participated in the race*

A central challenge in presupposition theory is how to account for Ps in complex sentences, where presuppositions commonly ‘project’, i.e., remain present at the utterance level de-

spite the presence of embedding operators. For instance, (8-a), (8-b) and (8-c) all give rise to the inference in (7-b) as well, while not conveying that the Bear won in any way.

- (8) a. The Bear didn't win the race.
- b. It is possible that the Bear won the race.
- c. Did the Bear win the race?

However, as seen in (4-a) above, (8-a) also has a reading without the inference. In order to account for this reading, traditional approaches assume an extra mechanism (e.g. local accommodation, Heim 1983) that results in the presuppositional content being treated on par with the asserted content. Thus in (8-a) the presuppositional content is interpreted in the scope of negation (i.e., *it's not true that Bear participated and won*); an interpretation that is compatible with a continuation negating the inference (e.g., *... he did not even participate!*).

2.1.3 Recent approaches to presuppositions

A number of recent proposals argue that (certain) Ps are actually more similar to SIs than assumed by traditional approaches (Abusch 2010, Chemla 2010, Romoli 2014).¹ In particular, Romoli (2014) treats the Ps of triggers such as *win* in parallel to strong scalar terms in the scope of negation (as in (6)). To illustrate the idea, the inference in (9-c) is derived from (9-a) as an SI invoking the same mechanisms assumed to underlie traditional SIs: the speaker said (9-a) when they could have said the more informative and relevant (9-b), leading the hearer to infer that (9-b) is false and thereby deriving the inference in (9-c).

- (9) a. The Bear didn't win the race.
- b. The Bear didn't participate in the race.
- c. \hookrightarrow *The Bear participated in the race*

This unified account predicts that SIs and Ps should generally behave uniformly. Any difference between them therefore poses a potential challenge. Our study builds on Bill et al. (2015) by evaluating how the differences found there relate to the performance of BAs.

2.2 Experimental background

2.2.1 Scalar implicatures

In the last decade or so, SIs have been the subject of a substantial body of experimental research (Chemla & Singh 2014, Katsos & Cummins 2010), both in processing by typical adults and in language acquisition. The general thrust of much of this work is that SIs are

¹There are also various recent proposals for analyzing SIs in different terms as grammatically based on silent exhaustivity operators Chierchia et al. (in press), Fox (2007). However, our present focus is on the relation between Ps and SIs, so we do not consider these proposals in detail here.

acquired later by children and processed slower by adults (starting from Noveck 2001, Bott & Noveck 2004). Work in acquisition has revealed a mixed picture for DSIs with results varying across types of SIs, experimental tasks, and ages (e.g. Geurts & Van Tiel to appear, Tieu et al. 2015). However, one robust finding is that the responses of children (aged around 4-5) are more likely than adults to be based on an interpretation lacking the SI inference.²

While typical adults generally tend to judge sentences such as (5-a) based on an interpretation that includes the SI inference, much processing evidence has been taken as indicating that these interpretations are nonetheless associated with a processing cost. This has been supported by both reaction time (e.g. Bott & Noveck 2004, Cremers & Chemla 2013) and eye tracking studies (e.g. Huang & Snedeker 2009), which report behavioral delays for SI interpretations. These delays have been attributed to a number of possible sources, e.g., the generation or the comparison of alternatives, the use of contextual information in deciding which alternatives are relevant or the complexity of the sentence meaning with and without the inference (Chemla 2009b, Chemla & Bott 2013). Note, however, that some recent research has questioned whether SIs are in fact associated with a delay (e.g. Grodner et al. 2010, Breheny et al. 2013, Schwarz et al. 2015), and we will return to this issue below.

2.2.2 Presuppositions

Until recently, Ps have received much less attention in the experimental literature (see Schwarz 2015 for a review of the existing work on Ps). That said, a recent study by Bill et al. (2015) indicates that in contrast to their behaviour with SIs, children readily compute P inferences but struggle with the suspension of Ps under negation (as in (4-a); see discussion in section 3 below). In addition, various reaction time studies (e.g. Chemla & Bott 2013, Schwarz 2014) indicate that Ps are not associated with a delay. In contrast, the interpretations without P-inferences of sentences with P-triggers have been found to be costly for typical adults (Chemla & Bott 2014, Romoli & Schwarz 2014). In other words, accepting a negative sentence with a P-trigger in a context that is compatible with its P is faster than one in a context incompatible with it (e.g. Chemla & Bott 2014, Romoli & Schwarz 2014). Hence, in contrast to SIs, it seems to be the absence, not the presence of the inference that results in higher processing costs for Ps.

2.3 Broca's aphasia and the comparative approach

Individuals with Broca's Aphasia (BAs) show an impairment on complex syntactic constructions such as non-canonical sentences where an argument has been moved from its original position (e.g. Grodzinsky 2000, Friedmann 2003).³ This has been attributed to a processing limitation that affects the correct instantiation of grammatical operations (e.g.

²Less research has focussed on ISIs, but the existing work suggests results parallel to those for DSIs (e.g. Musolino & Lidz 2006, Katsos & Cummins 2010).

³We use Broca's aphasia (BA) here to refer to a collection of symptoms associated with damage to the left inferior frontal gyrus. Agrammatic BA is a subtype of this syndrome. The main linguistic symptom of agrammatic BA is a reduction in the ability to produce coherent and complete sentences and a reduced ability to assign meaning to complex syntactic constructions in comprehension.

Avrutin 2006, Burkhardt et al. 2008) or to a more general reduction in processing resources that impacts the interpretation of ‘complex’ syntactic constructions (e.g. Caplan et al. 2013).⁴ Independent work from online tasks also indicates that BAs show evidence processing difficulties, as seen by delayed lexical access and delayed priming effects (e.g. Swinney et al. 2000, Love et al. 2008). It is possible however, that the performance of BAs on complex syntactic phenomena is only one piece of the puzzle. In order to refine the picture of the linguistic and processing capacities in BA, we need to move outside of the traditional domain of syntax to look at other ‘complex’ phenomena. Inferences such as SIs and Ps provide an ideal opportunity to expand the scope of research on comprehension in BAs and assess whether the observed impairment is syntax-specific or whether it affects ‘complex’ phenomena more generally, reflecting a domain-general processing limitation.

A further motivation for looking at this domain in BA is the well-known parallels between the linguistic profiles of BAs and children acquiring language (e.g. Jakobson 1971, Avrutin 2000 among many others), such that phenomena that are acquired later by children tend to be more vulnerable in BA. Whilst there is an extensive body of literature on children’s acquisition of pragmatic inferences (and SIs in particular), we are aware of no research to date that has investigated the comprehension performance of BAs on such inferences. Theories of SIs and Ps are often underspecified with respect to the link to the underlying processing mechanisms involved in their acquisition. Looking at them in comparison, however, provides a simple yet powerful tool for testing the predictions of unified accounts of how these inferences are derived. This approach has already been successfully applied to the study of SIs and Ps in children and adults (Bill et al. 2015). The current study extends this approach to the investigation of SIs and Ps in another population, namely individuals with BA, and compares their performance to that of the children and adults as reported in Bill et al. (2015).

3. Previous experiment: Adults vs. children

This section provides a detailed review of the Bill et al. (2015) study, as it formed the basis of the current study of BAs, and it provides the comparison data from typical adults and children. Using a version of the sentence picture matching task (The Covered Box task, e.g. Huang & Snedeker 2009), the main aim of the study was to evaluate the predictions of a unified approach that sees (certain) Ps as a type of SIs (see 2.1.3), by comparing typical adults (TAs; n=20) to two groups of children (16 4-5 year olds, 14 7 year olds).

⁴Note that earlier versions of grammatical accounts of comprehension in BA (e.g. The Trace Deletion Hypothesis, Grodzinsky 2000) attribute the comprehension pattern in BA to a *loss* of some aspect of grammar rather than to a processing impairment. However, more recent versions of TDH-type accounts are not committed to the idea that this is strictly a structural rather than a processing issue (Grodzinsky 2006, Friedmann 2003, Santi & Grodzinsky 2012).

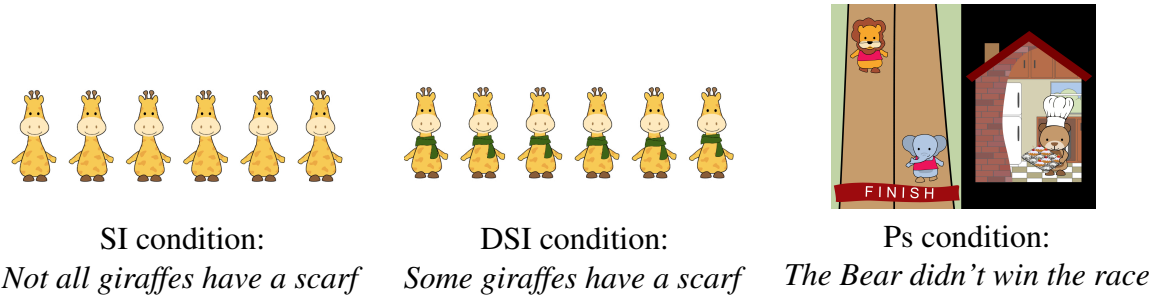


Figure 1: Illustration of target pictures used in critical trials.

3.1 Methods

3.1.1 Materials and procedure

Each trial consisted of a context picture and two test pictures, one visible and one covered. To 'set the scene' and to ensure felicity in accordance with the 'condition of plausible dissent' (Crain et al. 1996), the experimenter produced a short description of the context picture followed by a test sentence that described just one of the two (visible or covered) test pictures. The participant's task was to decide for each test sentence whether it described the visible or the covered picture. On the critical trials, the visible picture was only consistent with the literal meaning of the sentence. Its selection therefore indicated that the participant's response was based on an interpretation of the sentence without the relevant inference. Selection of the covered picture, on the other hand, indicated that the participants were accessing the inference. After a training phase with feedback, participants were tested on 12 target trials (4 trials per condition – DSI, ISI and Ps). Examples of visible pictures are shown in Figure 1. There were 12 control trials, 6 in which the test sentence was consistent with the overt picture and 6 where it wasn't and thus required a covered picture choice. These controls ensured that participants could correctly accept both the overt and covered pictures in the relevant contexts. Only participants who responded correctly to at least 3 out of the 4 controls per condition were included in the analysis.

3.2 Results and discussion

Logistic regression mixed effect models confirmed that the rate of covered box choices (indicating computation of the inference) depended on both group and type of inference. First, there was an interaction between Inference Type and Age Group. Secondly, there were significant simple effects of group for TAs vs children on both SIs and Ps, but in opposite directions, with more covered box choices by adults for SIs and more covered box choices by children for Ps.⁵ In other words, children were more likely than adults to respond based on a literal interpretation of SIs (consistent with the existing literature) whilst adults were more likely to respond based on an interpretation without the inference for Ps.

⁵In addition, there were some differences between DSIs and ISIs. See Bill et al. (2015) for details.

The results of this study pose a potential challenge for unified approaches to SIs and Ps, but are fully consistent with traditional approaches. This study provides novel evidence that while inference interpretations of SIs are hard for children (or, at any rate, less common), they are readily accessible when it comes to Ps. In other words, for Ps it is the interpretation without the inference that seems hard for them to access.

4. Current experiment

Given the similarities between acquisition and BA in other linguistic domains, as well as the commonly assumed processing limitations in this population, it is plausible that BAs would relate to SIs and Ps in similar ways, and thus struggle with SI interpretations as well as interpretations without the P inference, thus replicating the asymmetric performance of children on these phenomena. Utilising the same methods and materials as those described in section 3, the current study tested a group of individuals with BA and compared their performance to the adults and the children from (Bill et al. 2015). This approach provides novel data on the performance of BAs on ‘complex’ phenomena outside the traditional domain of syntax. It also extends Bill et al. (2015) to further inform the theoretical debate about the relationship between SIs and Ps.

4.1 Methods

4.1.1 Participants

Nine individuals diagnosed with BA (age 48-63 years, $M=53.4$, time post onset 1.4-9 years, $M=5.6$) took part in the study.⁶ They were selected on the basis of several criteria: (i) Assessment on the Western Aphasia Battery (WAB, Kertesz 1982) (ii) typically agrammatic speech production and (iii) impaired comprehension performance on non-canonical sentences (Passives and object clefts) on the Verb and Sentence Test (VAST, Bastiaanse et al. 2003). They all showed an asymmetry in performance on canonical and non-canonical sentences indicating evidence of a processing limitation. The adults and children groups were those of Bill et al. (2015).

4.2 Results

The rate of covered box choices (indicating the inference interpretation) for the three groups is shown in Figure 2a below. Figure 2b shows the covered box choices for the BAs, typical adults and the group of 7 year old children. As there was no significant difference between the DSI and ISI condition for BAs, we pooled the results for SIs. Similarly, the results for 4-5 and 7-year olds were pooled for the present analysis as well. The main focus of analysis were tests of interactions between group (BAs vs. TAs and BAs vs. Children) and inference type (SIs vs. Ps), using logistic regression mixed effect models.

First, looking at the comparison between BAs and TAs on SIs and Ps, we found a group by inference type interaction ($p < .05$), due to the higher rate of selection of the

⁶Individuals with BA were all recruited from StrokeNI.

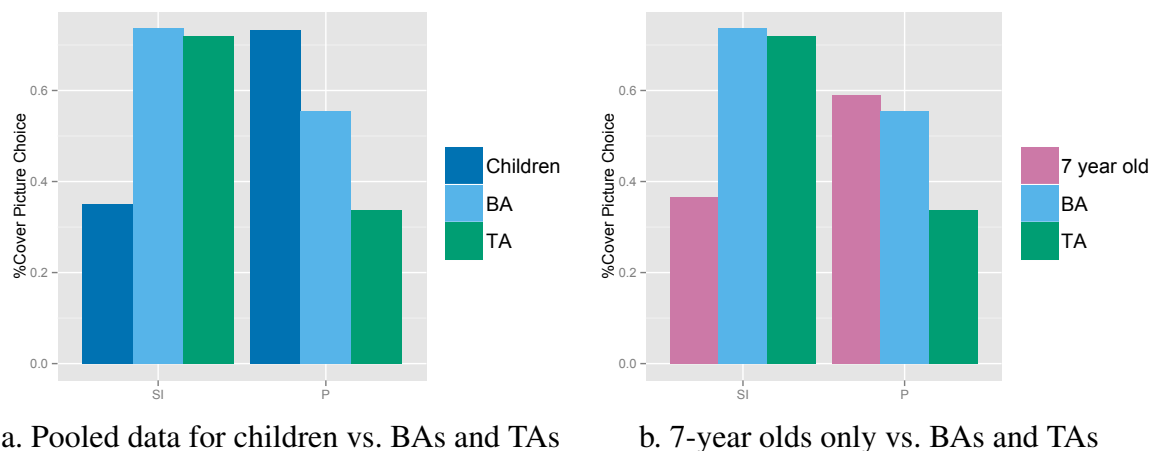


Figure 2: Rate (%) of CB choices by group on SIs and Ps

covered box option by BAs for Ps at a marginally significant level ($p < 0.1$). Covered box rates were higher for SIs than Ps for both typical adults ($p < .001$) and BAs ($p < .05$). No effect of group was found for SIs ($p > .9$). Turning to the comparison between BAs and children, there was again an interaction ($p < .001$), which was driven by a simple effect of inference type for children ($P > SI$; $p < .001$) that went in the opposite direction as that for BAs (as well as adults; for details on this comparison, see Bill et al. 2015). BAs had significantly higher covered box rates than children for SIs ($p < .01$), while they did not differ significantly for Ps ($p = .15$). Whilst BAs tended to reject the overt picture more frequently than adults on both the SI and P conditions, this cannot be simply related to a response bias (choosing the cover box) as all participants included in the analysis showed that they could correctly accept and reject the overt picture in the relevant contexts on the control trials.

In sum, BAs were on a par with typical adults with SIs in giving an inference-based response in the majority of cases. In contrast, BAs were more similar to children for Ps, with elevated rates of covered box choices relative to the typical adults. In addition, when we look at the comparison between the 7-year-old children and BAs, we find that these groups are completely on a par with respect to the P condition, as shown in Figure 2b.

5. Discussion

The current study investigated the interpretation of SIs and Ps in a group of BAs and compared their performance to data from children and typical adults from Bill et al. (2015). This study had two main goals. The first goal was to provide novel data on how BAs engage with sentences containing two types of inferences. The results indicated that despite the potential processing cost associated with SI inferences, BAs performed in-line with typical adults, and generally responded based on the inference interpretation. Their performance on Ps, however, was more comparable to children (in particular, the group of 7-year

olds), in that they were less likely than typical adults to respond based on an interpretation without the relevant inference.

Starting from the second point, the outcome is in line with previous findings that suggest that accessing an interpretation without a P-inference is associated with a processing cost, such that responses based on interpretations with the inference are faster than those based on interpretations without the inference (Chemla & Bott 2014, Romoli & Schwarz 2014, among others). This may be related to the role of an additional mechanism, such as ‘local accommodation’ (Heim 1983), which is required to access a reading without the inference. The fact that BA’s performance on Ps is comparable to that of children further adds to the hypothesis that the processing challenges they face correspond to phenomena that are relatively late in acquisition. In sum, the results of the current study show that BAs have a specific difficulty with accessing interpretations without the P-inference in the relevant sentences due to a limitation in processing resources. This provides evidence that these BAs show an impairment on complex phenomena outside of the domain of syntax.

In contrast, BA’s performance on SIs, which is parallel to that of typical adults, is surprising in light of arguments in the literature that the mechanisms underlying SIs are associated with a processing cost (e.g. Huang & Snedeker 2009, Chemla & Bott 2014). The question is why BA’s performance on SIs is not affected by this assumed processing cost. There are two potential hypotheses to explore. First, these results could be seen to suggest a selective deficit in BA, affecting the processes underlying Ps cancellation but sparing those underlying SIs, presumably due to underlying differences in processing these inferences. However, it is not necessarily clear at this point exactly how to characterize such a difference in processing cost. Under this hypothesis, the results could provide evidence that BAs do not suffer from a domain-general reduction in processing abilities, but a selective deficit, which affects the process involved in generating interpretations without P-inferences (such as local accommodation), perhaps because this involves a type of complexity broadly similar to the well-studied cases of complexity associated with various syntactic phenomena.

An alternative account of the performance asymmetry on SIs and Ps is that BAs do not struggle with SIs because they are not *as* costly as previously assumed. This would be consistent with recent eye-tracking studies (e.g. Grodner et al. 2010, Breheny et al. 2013), which appear to indicate that SIs are computed immediately and not delayed in relation to the literal interpretation. Under this interpretation we can derive a more uniform pattern of performance in BA, where performance deviates from typical adults specifically in cases where there is an increased processing load. This would also be consistent with certain processing-based accounts of comprehension in BA, which propose that complex linguistic phenomena are affected as a factor of their relative complexity (see Caplan et al. 2013 for a review of the evidence for such an account). In sum, if we assume that SIs are not (*that*) costly, we would not expect them to pose a challenge for BAs. Assuming this hypothesis leaves us with the challenge of explaining children’s well-documented performance with SIs, specifically the fact that they are more likely to respond based on a literal interpretation of a sentence. In this regard, various proposals in the literature argue that children’s problems with SIs are in fact not related to the processing cost of these inferences, but to other factors such as lack of knowledge of the relevant lexical alternatives or

difficulty in accessing them (Barner et al. 2011, Chierchia 2011; also see Tieu et al. 2015), or to children's increased tolerance for pragmatic infelicity (Katsos & Cummins 2010).

The second overall goal of this study was to further investigate the comparison between SIs and Ps in relation to the theoretical debate outlined in section 2.3. The present findings are parallel to those of Bill et al. (2015) and provide further evidence that SIs and Ps differ. This is *prima facie* more consistent with a traditional approach which distinguishes SIs and Ps theoretically. In contrast, they represent a challenge for uniform proposals (e.g. Romoli 2014), which derive Ps and SIs in parallel ways (but see Bill et al. 2015 for discussion of a proposal on how this approach could be modified to explain this asymmetry). Finally, the current study further investigated the hypothesis that there are similarities in linguistic comprehension between BAs and children. The results indicate that whilst BAs appear to perform like children on Ps, they perform like adults on SIs. This finding provides novel evidence for divergent performance by children and BAs on 'complex' phenomena beyond the domain of syntax.⁷

6. Conclusion

The current study provides novel evidence on the interpretation of SI and P-inferences in BAs and adds further evidence for a traditional approach to SIs and Ps. More specifically, the study had two main goals. The first goal was to provide novel data on the interpretation of SIs and Ps in BA in order to refine the picture of what is impaired and retained in this disorder. The results indicate an asymmetry in the performance of BAs on SIs and Ps in comparison to typical adults. This could implicate a selective deficit, affecting the processes underlying access to interpretations without a P-inference and sparing those underlying SI interpretation due to underlying processing differences. Future research will further investigate the potential underlying processing differences between SIs and Ps in BA by investigating whether the difference on behavioural measures is also reflected in processing measures such as reaction times and eye movement patterns. Alternatively this result could imply that responding based on a SI is not costly whilst responding based on an interpretation whereby a P has been suspended is costly (consistent with processing data on typical adults, e.g. Chemla & Bott 2014). In relation to the second goal of the study, the results indicate that, in line with the findings of Bill et al. (2015), BAs also show an asymmetric performance on SIs and Ps. This provides further evidence against a unified approach to these inferences. In comparing acquisition and aphasia, we found that BAs differed from children on SIs but performed in a similar way on Ps. This provides evidence from a novel domain for an asymmetry in the performance of BAs and children and may implicate different underlying sources for the linguistic performance of these populations. A further extension of this work would involve extending the multidimensional compara-

⁷Considering that BA has traditionally been characterised as a grammatical disorder (e.g. Grodzinsky 2000), one might be tempted to interpret the performance of this group on SIs as evidence for a more pragmatic approach to the derivation of these phenomena. However, considering that the status of the grammar in BA is still a matter of debate, we cannot conclude that their performance on SIs vs. Ps can inform the ongoing debate on the grammatical vs. pragmatic status of SIs. Thanks to Kathryn Davidson (p.c.) for discussion on this point.

tive approach with these three populations to the investigation of similar types of inferences in BAs (for example plurality inferences; see Tieu et al. 2014).

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